



**Washington State
Department of Transportation**



WSDOT Statewide Intelligent Transportation Systems (ITS) Plan

FINAL

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Summary

Intelligent Transportation Systems, or ITS, improve transportation safety and mobility and enhance productivity through the use of advanced communications technologies and the integration of advanced communications technologies into the transportation infrastructure and vehicles. Intelligent transportation systems encompass a broad range of wireless and wire line communications-based information and electronics technologies.

The purpose of the Washington State Department of Transportation (WSDOT) Statewide Intelligent Transportation Systems (ITS) Plan is to 1) identify the near- and long-term ITS needs to meet the objectives identified in WSDOT's 2009-2015 Strategic Plan and *Moving Washington*, WSDOT's vision of investments and priorities over the next 10 years; and 2) to identify specific ITS projects designed to implement strategies identified in *Moving Washington*.

The Statewide ITS Plan is a comprehensive document that discusses:

- The history of ITS deployment in Washington
- How ITS meets the WSDOT's transportation vision and goals
- The current state of ITS deployment
- WSDOT's near-term ITS plans
- How projects listed in Appendix A were prioritized, and
- What long-term ITS issues WSDOT needs to begin planning for.

Key ITS investments are required to make portions of the Strategic Plan and *Moving Washington* successful. These key areas include:

1. Expanding ITS communication capabilities for delivering real-time information to the travelling public, our local agency partners, media and other users of transportation data WSDOT generates.
2. Installing ITS field devices and incident response vehicles in new locations, and replacing aging devices that are becoming obsolete.
3. Upgrading Traffic Management Centers (TMCs) in the Northwest, Olympic and South Central regions so they can better manage traffic demands.
4. Building upon WSDOT's successful ITS investments by implementing Active Traffic Management (ATM) techniques along our most congested corridors.
5. Continuing to monitor and participate in evolving ITS technologies and programs such as the Federal Highway Administration's (FHWA's) Vehicle Infrastructure Integration (VII) effort.
Investing in equipment and personnel necessary to operate and maintain WSDOT's existing and future ITS program.

Specific projects are listed in Appendix A. They are divided into two categories: a

prioritized list of projects that should be underway in the 2009-2011 biennium, and a second list of projects for the 2011-2019 timeframe. All are critical to the success of WSDOT's Moving Washington initiative.

I. A Brief History of ITS Deployment

Intelligent Transportation Systems (ITS) are the application of computers, communications and sensor technology to surface transportation. Most transportation agencies began using technology to manage transportation problems long before the term ITS became popular. Most of these efforts were directed towards the relief of urban congestion. Freeway management systems and coordinated traffic signal systems were installed to improve the efficiency of urban freeways and arterial roadways. The Washington State Department of Transportation (WSDOT) was an early proponent of these techniques, particularly in the Seattle area, where it was, and continues to be, prohibitively expensive, due to geographical constraints, to add freeway lanes. Instead, WSDOT used freeway management techniques like ramp metering and operational strategies like High Occupancy Vehicle (HOV) lanes to try to squeeze the maximum efficiency from the freeway system.

Today's improved capabilities in computers, communications and sensors allow the application of ITS in places and ways that weren't previously feasible. In 1993, WSDOT prepared an Intelligent Vehicle Highway Systems (IVHS) Strategic Plan for Washington State, called "Venture Washington". The plan provided geographically focused recommendations in five categories based on an assessment of problems throughout the State. Those categories were:



- Public Transit and Transportation Demand Management
- Traveler Information
- Traffic Management
- Freight and Fleet Management
- Additional Services (emergency services, enforcement, safety and security)

In 1996, WSDOT prepared an ITS Six-year Action Plan that developed specific project recommendations based on the general recommendations of the IVHS Strategic Plan. In the ten years that followed the preparation of the Action Plan, much progress in the installation of ITS infrastructure occurred. The funding source for much of this infrastructure, particularly the infrastructure installed in rural areas, was federal ITS deployment funds provided through Congressional earmarks. The Washington State Legislature provided state matching funds for these ITS earmarks that made it possible for WSDOT to utilize the funds. Federal fiscal year (FY) 2005 was the last year that the US Congress provided ITS earmarks.

A great deal of the urban ITS infrastructure, particularly on Seattle area freeways, was installed as part of freeway reconstruction or HOV lane construction projects. For example, the first WSDOT fiber optic communications cable was installed in

the 1990s as part of the replacement of the Interstate 90 floating bridge in the Seattle area.

Twice in the past 5 years, the Washington State Legislature has voted to increase the gas tax to fund transportation improvements. These funds are allocated for a long list of improvement projects proposed for every state highway across Washington State. With the demise of the ITS earmarks, WSDOT now needs to incorporate ITS work into these improvement projects in the same way that this work was added to Interstate Highway construction projects. In order to do this, a detailed ITS plan is required to identify the statewide ITS needs by location and priority.



This plan will provide explanations for the installation of ITS infrastructure and the benefits to be expected.

II. Vision and Goals: *Moving Washington* and WSDOT's Strategic Plan

Moving Washington is a three-part strategy to reduce traffic congestion in our state. The strategy details three complementary elements: adding capacity strategically, efficiently operating the existing system, and providing choices that help manage demand.

Advanced technology, or ITS, is one of the key tools in two of the strategic elements: operating efficiently and managing demand. While *Moving Washington* and the Strategic Plan discuss goals and objectives for improving traffic in Washington state, this ITS Plan discusses how ITS will be used to meet those goals. In addition, Appendix A lists specific ITS projects WSDOT must implement to realize the benefits envisioned in *Moving Washington* and the Strategic Plan.

WSDOT's Business Direction: Move people, goods, and services reliably, safely, and efficiently, by adding infrastructure capacity strategically, operating transportation systems efficiently, and managing demand effectively.

Operating efficiently means getting the most out of the infrastructure we already have. Much of this is done using relatively low cost traffic ITS technologies such as electronic tolling, Traffic Management Centers (TMCs), traffic cameras and other surveillance devices, Variable Message Signs (VMS), Highway Advisory Radios (HAR), and ramp meters.

Managing demand means promoting and sponsoring travel options for travelers that result in greater efficiency for the transportation system. ITS strategies to help manage demand include real-time traffic information displayed for drivers on variable message signs and variable tolling based on traffic volume or time of day. These options shift demand away from the parts of the system that are overburdened, on a particular route or at a particular time of the day.

Deploying ITS components identified in Moving Washington and listed in this plan supports the following objectives of WSDOT's 2009-2015 Strategic Plan:

1.8 - Continuity of Operations and Emergency Management and Response: Increase WSDOT's ability to respond to, recover from, and deliver vital services during emergencies and disasters.

Business Directions: WSDOT's 2009-2015 Strategic Plan

2.1 - Highways and Bridges Maintenance: Maintain highway and bridge systems to optimize their short and long-term usefulness and minimize life-cycle costs.

2.10 - Traffic Operations Equipment Preservation and Upgrades: Preserve and upgrade traffic operations equipment, such as traffic signals, variable message signs, and information technology and communications systems, to meet existing and future highway operations needs.

3.3 – Traffic Management (Operating Efficiently): Optimize efficiency of the existing system by improving and expanding traffic management to increase the operating capacity of highways and reduce the causes and severity of congestion.

3.4 – Traveler Information (Operating Efficiently): Provide user-focused information so the public can

make informed decisions about when, where and how to travel – “all roads, all modes, all the time.”

3.5 – Variable Tolling (Managing Demand): Provide funding for highway and bridge improvements, and make more efficient use of available roadway capacity through the use of high occupancy toll (HOT) lanes and express lanes.

3.6 – Demand Management (Managing Demand): Increase vehicle occupancy and use of transportation services and commute choices.

3.7 – Highways and Ferries Operations (Operating Efficiently): Monitor, analyze, and report performance of highways and ferries system operations. Expand “real time” monitoring and analysis of highways and ferries to support travel decisions made by the public, better manage operations, and improve system performance.

4.3 – Climate Change: Reduce transportation contributions to climate change. Address impacts of climate change on transportation infrastructure and operations.

As mentioned previously in the discussion of the 1993 IVHS Strategic Plan for Washington State, WSDOT focused resources on several categories of projects. ITS projects have always suffered from a need to emphasize the technologies that must be implemented before a benefit can be realized. Often a considerable amount of infrastructure must be deployed before an application that provides tangible benefits can be introduced. The following are the areas where national and WSDOT experience indicate that ITS can provide the most benefit to the

transportation system:

- Provide an integrated network of transportation information. This includes real-time information on the physical state of the infrastructure, how it is being built, used, maintained and kept secure, as well as its environment, including relevant weather conditions and predicted conditions.
- Improve safety and crash avoidance. This can be accomplished by providing real-time traveler information on collisions. This will result in fewer secondary collisions as motorists avoid the crash scene. It also involves the development, integration and deployment of in-vehicle electronics, vehicle and highway automation and selective automated enforcement, including the determination of fitness to drive.
- Improve the detection of incident occurrence and severity, notification and response. This involves providing public safety responders with timely notice of an incident, efficiently routing them to the scene and to the hospital, and giving them the ability to assess and convey the nature and degree of injury to the travel center.
- Providing advanced transportation management. This involves area-wide surveillance and detection, rapid acquisition of traffic flow data, real-time evaluation of traffic flows, predictive capabilities and evaluation of operational strategies. Active Traffic Management, Integrated Corridor Management and Congestion Pricing Strategies are all part of this effort and are described in more detail in later sections.

“The core strategies to accomplish these goals include expanded use of TMCs . . .”

The core strategies to accomplish these goals include expanded use of TMCs to actively manage traffic; more widespread use of field devices such as ramp meters, highway advisory radios, variable message signs, surveillance equipment, and road and weather information systems; new communications systems including fiber optics and wireless technologies; innovative traveler information systems; additional data collection and management tools; and improved freight and intermodal systems.

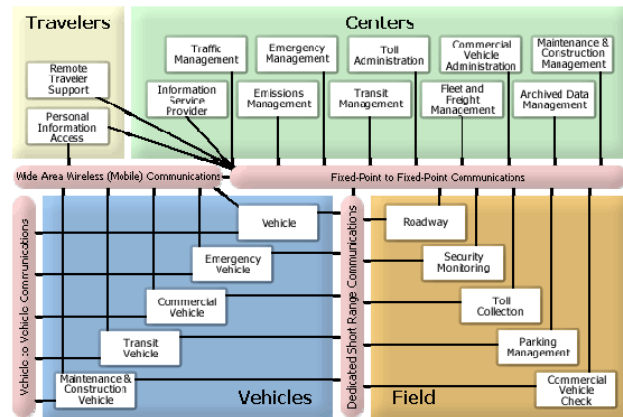
III. The Current State of Deployment

NOTE: The following discusses the current state of deployment in general terms. A detailed inventory of ITS deployments and devices is not included. The reason for this omission is to avoid making a document that is obsolete as soon as it is published. The current ITS inventory is located on WSDOT’s GIS Workbench (http://wwwi.wsdot.wa.gov/GIS/supportteam/gis_workbench/default.asp).

ITS Plans and Architectures

WSDOT was one of the first state departments of transportation to develop a statewide ITS plan (1993). This provided general guidance to set the direction of WSDOT's ITS program. It was followed by a Six-Year Action Plan (1996) that provided more specific guidance for the program. As the opportunity to attract increased ITS earmark funding arose, WSDOT's six regions developed project lists and implementation plans. Because federal funds were involved in these projects, it also meant that an ITS Architecture was required. ITS architectures were first developed in the following areas of the State that include most of the major urban areas:

- Spokane County (Spokane)
- Clark County (Vancouver, WA)
- The four counties of central Puget Sound: Kitsap, King, Pierce, and Snohomish Counties (Seattle and Tacoma)
- Thurston County (Olympia)
- Whatcom County (USA/Canada border area)



In 2001, FHWA and FTA implemented the TEA-21 requirement that all ITS projects using federal funding must conform to the National ITS Architecture and ITS technical standards. The Washington State ITS Architecture and Regional ITS Architectures for WSDOT's North Central and South Central Regions were developed in 2002, and updated in July 2006. An ITS 10-Year Vision Plan (2005-2014) was prepared in 2005 for inclusion in the 2005-2015 Maintenance and Operations Plan. This plan updates the 2005 effort.

Traffic Management Centers

WSDOT currently has traffic management centers (TMCs) in each of its six regions. Centers are located in:

- The Seattle area (actual location in Shoreline)
- The Tacoma area (actual location in Parkland)
- Spokane
- Vancouver
- The Yakima area (actual location in Union Gap)
- Wenatchee
- Bellingham



WSDOT Seattle Area Traffic Management Center

In addition, the South Central Region operates a traffic operations center at Hyak, responsible for coordinating winter operations on Snoqualmie Pass with the Union Gap TMC.

Current efforts are underway to design a new, combined Seattle area TMC and emergency operations center (EOC) that will be located at WSDOT's Shoreline facility.

The TMCs have somewhat different missions, based on their local environment and populations. The Seattle, Tacoma, Spokane and Vancouver TMCs focus on freeway management. The Northwest, Olympic, Southwest and Eastern Regions are dominated by Interstate Highways: I-5 for the first three and I-90 for the last one. The Seattle area TMC is the only one that operates an extensive ramp metering system. The Tacoma area TMC operates several ramp meters on the SR 16 approach to the Tacoma Narrows Bridge and one meter on I-5.



WSDOT Wenatchee Traffic Management Center

Of all of the WSDOT TMCs, the Spokane TMC is the only one that has a significant role in operating a traffic signal system. It is also the only one that is operated as a partnership of six transportation agencies in the region. These agencies are the City of Spokane, City of Spokane Valley, Spokane County, the MPO, Spokane Transit and WSDOT. The Tacoma, Vancouver and Yakima TMCs are co-located with the Washington State Patrol (WSP).

All of the TMCs play a major coordinating effort in incident management. In all cases, except for the Bellingham TMC, the Region radio communications room is located at the TMC. These coordinate communications with WSDOT Maintenance (including Incident Response) and Construction resources and the Washington State Patrol. The Yakima area and Wenatchee TMCs are also involved in coordinating incident response but their major focus is the coordination of maintenance efforts to keep the State's mountain pass highways open during the winter. The focus of the Bellingham TMC is primarily coordination of the expanding system designed to provide border crossing wait times and other travel information to those heading north to Canada.

As a result of these different emphasis areas, the software used in these systems is different. The Seattle area software is custom developed to operate their ramp meter algorithm. The Spokane area software is "commercial off the shelf" and runs the area's traffic signal system. The Vancouver, WA TMC software will eventually be compatible with the software that the Oregon Department of Transportation

uses to operate its TransPort freeway management system in the Portland area. In Spokane and Vancouver, the priority to coordinate with regional partners was, and is, higher than that to be compatible with other WSDOT TMCs.

This diversity of missions and the accompanying software, in addition to the large geographical distances between TMCs, has made it difficult to achieve center-to-center communications and standardized operating procedures. Various efforts are underway to remedy this situation. WSDOT is using xml as a standard for communicating between TMCs. The NW Region is implementing a regional project, called Traffic Busters, which will allow approximately 20 agencies in the central Puget Sound to connect to the WSDOT fiber optic network and exchange traffic video. This project will lead the way in center-to-center communications and will serve as a model for exchanging data and information, both between WSDOT centers and between WSDOT and local agency centers. In addition, WSDOT has provided research funds for the Washington State Transportation Center (TRAC) to recommend a method of archiving statewide data such as traffic volumes, lane occupancies, speeds, incidents and weather data. TRAC has prepared a Request For Proposals (RFP) for the purchase or development of the recommended archive system called Performance Measurement Systems (PeMS). In order for this data archive to operate, data exchange standards will be needed between HQ and the region TMCs.



In order to standardize operating procedures between TMCs, TMC operators hold periodic meetings lead by the ITS Field Operations Engineer. In the NW Region, the Puget Sound Regional Council is leading an effort to develop a “regional concept of operations for regional operations”. It will be used when the Traffic Buster project is complete and agencies have the ability to share data and, in some cases, control of traffic signal systems.

Field Devices

WSDOT manages its roadways with a fairly standard array of field devices. These include ramp meters, closed-circuit TV cameras, loop detectors, highway advisory radios, variable message signs, and road weather information systems. There are a small number of video detectors and radar detectors in use around the State. The following table gives the estimated number of field devices deployed in the State:

- Freeway loop detectors = 5,000
- Video detectors = 15
- Radar detectors = 25
- Traffic signal loops = 15,000

- Closed-circuit TV cameras = 500
- Ramp meters = 170
- Highway advisory radio transmitters = 60
- Variable message signs = 180
- Road weather information systems = 95

In addition to these systems, WSDOT has deployed other systems on a limited basis. Some examples of these deployments are:

- License plate readers to provide arterial road travel times
- Toll tag readers for the Tacoma Narrows Bridge and the SR 167 HOT lanes
- Variable speed limit systems that set speed limits based on weather or road conditions are in operation on I-90 and US-2 where they cross mountain passes

The current inventory and locations are located on the GIS Workbench (www.wsdot.wa.gov/GIS/supportteam/gis_workbench/default.asp).



SR 167 HOT Lanes

Communications Systems: Fiber Optic Cable

WSDOT has over 160 miles of fiber optic communications cable installed within state highway right-of-way. Most of this is in the Seattle area but fiber is also installed in the Spokane, Tacoma and Vancouver areas. This fiber is used to carry data and video images between the field devices and the TMCs. The fiber system is primarily an analog system that supports both analog and digital transmission. Most of the system uses single mode fiber with a small percentage being multi-mode. The Seattle area fiber network was designed to use SONET technology built in rings but the ring topology has not been completed.

Communications Systems: Wireless

WSDOT has an 800MHz wireless radio system for voice communication with its field personnel. There are also direct connections, in most cases, between WSDOT TMCs and WSP dispatch centers. (As mentioned previously, the Vancouver, Yakima and Tacoma TMCs are collocated with WSP facilities.) There is nearly complete coverage of the state highway system. There is, however, no wireless data transmission system. As noted previously, there are radio rooms located in 6 of the 7 TMCs. Five of these operate 24/7 and one, Wenatchee, operates only during normal



WSDOT Wireless 800 MHz Radio Tower

working hours. The Bellingham TMC is the only one that lacks a radio room.

WSDOT is part of a national effort to reband public agency radio networks from the 800MHz frequencies to spectra in the 700MHz band. This is being done to eliminate interference between the public agencies and various private sector cell phone providers that also use spectrum in the 800MHz band. Since they are the cause of the interference, the private sector companies have been directed to pay for this rebanding effort in exchange for the use of the public agency 800MHz spectrum. The first phase of this rebanding effort is a three-year planning phase that starts in January 2008. The rebanding effort may facilitate the required migration to a P25 digital trunking system that will provide some interoperability with law enforcement and other agencies. This effort will replace a great deal of existing outdated infrastructure and equipment with the latest technology in radio systems but falls short of making necessary upgrades and expansions to the system.

WSDOT's ITS and Wireless Communications group is also exploring ways to provide wireless bandwidth for data transmission. Work is underway to test a low speed 700MHz system with some 4.9GHz high speed hot spots. A pilot project in the North Central Region is scheduled to take place in 2008-2009.

Wireless communication does provide a small number of critical links in the ITS system. Some of the key systems around the state utilizing wireless communications include the Tacoma Narrows Bridge traffic cameras, a Benton County Emergency Services/Yakima TMC connection to distribute video and data along I-82, cameras to support the movement of nuclear waste from the Port of Hanford near the Tri-Cities, and improved traveler information along the U.S./Canada border to support the 2010 Winter Olympics in Vancouver, B.C.

Traveler Information Systems

WSDOT uses traditional tools for delivering traveler information, such as Highway advisory radios and variable message signs. In addition, WSDOT also provides Internet-based travel information (www.wsdot.wa.gov/traffic/) and telephone-based travel information (511). Congestion maps are available on the web site for Seattle, Spokane, Tacoma, and Vancouver. Versions of the congestion map are available for use on web-enabled cell phones and PDAs on the WSDOT website (www.wsdot.wa.gov/small). Many other types of travel information are provided on the WSDOT web site. Some examples are:



- Travel times
- Closed-circuit TV images
- Incident information
- Construction traffic impacts

- Weather information (both current and predicted)
- Road conditions – including mountain pass reports
- USA/Canada border crossing delays
- Variable message sign and highway advisory radio message content

Data Collection and Management

WSDOT has an extensive archive of freeway volume and lane occupancy data as well as an extensive archive of HOV lane volume, vehicle occupancy and travel time data. These data are available from the Washington State Transportation Center (TRAC) or from WSDOT. Various customized data reports can be prepared that depict speed, delay or congestion. The public can use the WSDOT web site to see archived versions of the Seattle area FLOW map dating back to January 2005. The Eastern Region uses a vendor developed data archive and management system called the Performance Management System (PeMS) that can also display traffic volumes, speed, delay and congestion.



Weigh in Motion System

Freight and Intermodal Systems

WSDOT has installed the Commercial Vehicle Information Systems and Networks (CVISN) technology, including weigh-in-motion systems, at 11 locations in Washington (on I-5, I-82 and I-90). Vehicles equipped with CVISN transponder tags can bypass weigh stations if they are of legal weight and pass registration and safety scans. The truck is weighed at freeway speeds and a tag reader identifies the truck. National and state databases are scanned for over a dozen parameters to see if the truck has complied with registration, tax and safety requirements. If so, the truck is given a green light to bypass the weigh station. If not, the truck is given a red light and must pull into the weigh station for further scrutiny. There are approximately 51,000 transponders in use by 6,990 carriers.

WSDOT has also conducted operational tests that explored the use transponders to assist with the US Customs and Border Protection inspection process at the USA/Canada border. A test of the use of electronic container seals for container security and tracking has been underway for several years.

IV. Future Plans

The following sections discuss WSDOT's future plans in each of the four ITS areas that have the potential to deliver the greatest benefits.

1. Provide an integrated network of transportation information.

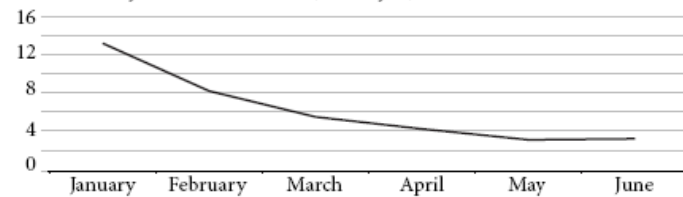
Opportunities: WSDOT recognizes its obligation to collect and disseminate real-time information on the physical state of the infrastructure, how it is being built, used, maintained and kept secure. Information on the environment that surrounds that infrastructure, including relevant weather conditions and predicted conditions, is also important to collect and disseminate. It is important to note that security

concerns may restrict the dissemination of some infrastructure-related information. This network of information is the foundation upon which all aspects of transportation management are built. It permits agencies to efficiently manage both the physical infrastructure and the operations that use that infrastructure. It enables agencies to identify safety risks and mitigate them. It allows travelers to make informed choices on the best route, both in advance and en-route, based on real-time and predictive information. It helps shippers, carriers and freight terminal operators interact to move freight in the most efficient way possible.

Engineers have always collected and analyzed information about the transportation system. ITS provide additional tools for information collection and use. However, information about the transportation system remains sparse, fragmented and uncoordinated. More and different types of data are needed. Some

WSDOT travel and traffic website usage

Total monthly views, in millions, January - June 2008



Data Source: WSDOT Communications Office.

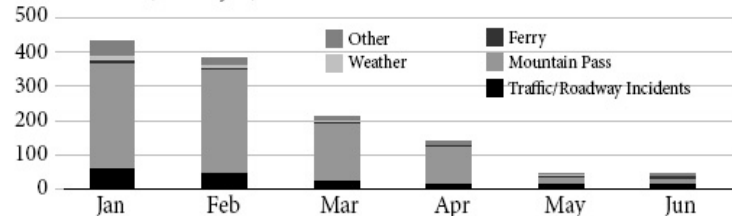
examples are: arterial traffic volumes and speeds, system-wide travel times for cars, transit and trucks, infrastructure status for security and for programming maintenance or replacement, and true pavement surface conditions. The good news is that the strong foundation for the collection, analysis and dissemination is in place. Data based performance measurement has become an integral part of WSDOT management philosophy. The future direction is to build on this foundation by installing more data collection devices and more communications capability, developing more analysis capability and delivering more traveler information.

Benefits: An information system, by itself, does not deliver direct benefits. But the information that it generates can result in improved system operations and improved travel information.

The benefits in system operations are realized through improved system management, both during daily events and when crises occur. Improvements in travel information can result in improved operations also as travelers choose an alternate route, time of travel or mode of travel. Even if it is not feasible to make any of these changes, improved travel information can result in reduced stress due to less uncertainty during travel. Improvements in personal mobility can also be realized when people have greater control over their travel. For example, people may use travel information to combine several errands into one trip, thereby gaining greater

Types of information requested from 5-1-1 traveler information

In thousands, January - June 2008



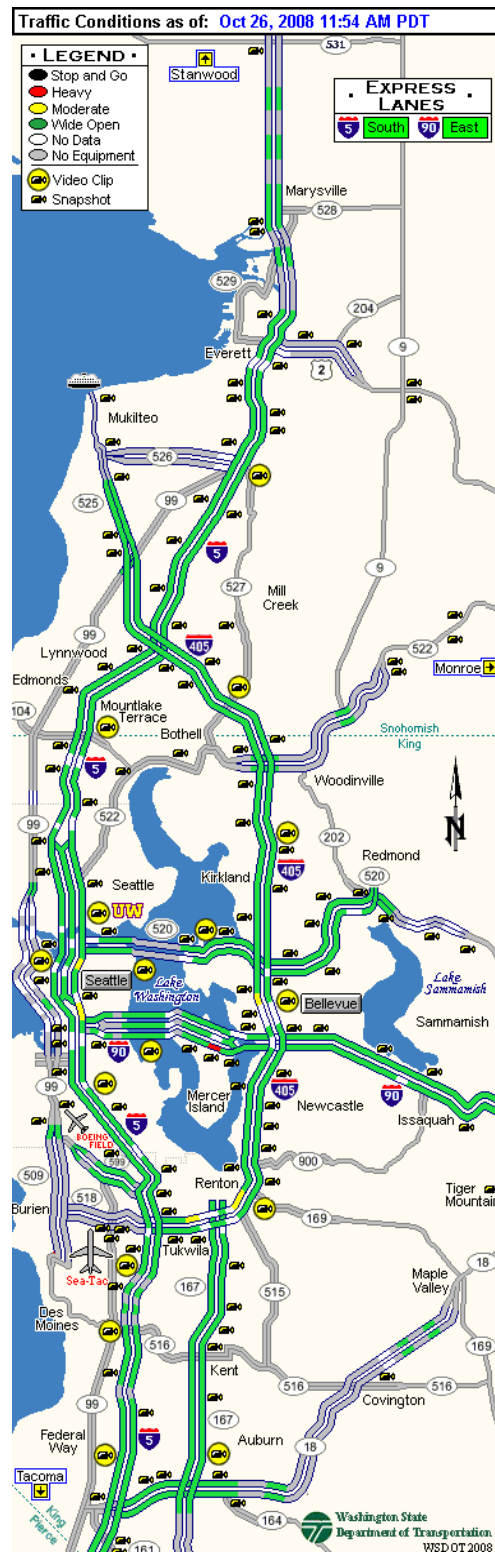
Data Source: 5-1-1 INI (Interactive Northwest Inc.) Activity Summary-Combined Report, Avaya BCMS combined report of FBX and VDN Daily historical numbers, WSDOT Traffic Office.
 Note: Total number of information types will not add up to the total number of calls to 5-1-1 because more than one type of information may be requested in one call, or one caller may hang up without selecting a category. Only completed calls are recorded.

benefit from their travel. Improved travel information enables freight movers to improve the reliability of their trips leading to reduced transportation costs and, therefore, reduced overall costs for goods. Along with improved operations and travel efficiency comes improved safety. As drivers use information to avoid incident locations, they reduce their chances of being involved in secondary collisions. There is also an intangible but significant element. In this information age, increasingly the public simply wants to know the conditions they will encounter on their trip. To the traveler, even the smallest amount of information is valuable. Just an awareness of what to expect and a description of the congestion ahead provides the traveling public with peace of mind and the perception of a safer, more secure trip. Studies, and feedback WSDOT has received, suggest there is value in providing what our customers expect, even though the system benefits cannot be easily measured.

Challenges: As with almost all aspects of transportation operations, the challenges to achieving improved information integration are almost all institutional or jurisdictional in nature. Incentives do not exist, in many cases, to convince people of the value of sharing data. Data collection, communications, database management, travel information, etc, are not considered of sufficient importance for more than relatively minor amounts of funding to be spent on them.

The lack of monetary benefits that can be assigned to improvements in travel information is also a problem. The reduction of stress due to less uncertainty is a good example. The stress reduction may result in fewer road rage incidents but, so far, it has been impossible to quantify those benefits.

WSDOT was one of the first agencies in the country to offer freeway congestion information to the public. Initial efforts provided Seattle area travel information to the local radio and TV traffic stations and they augmented it, in some cases with reports from their own traffic reporters or those of commercial traffic reporting companies, and delivered it to the public. WSDOT worked to maintain good relations with the traffic reporting media and



recognized the important role that they played in delivering information to the public. As technology made it possible for WSDOT to economically deliver the information that it collected for traffic operations to the public, it began to deliver information using the Internet, telephone hotlines and television.

From the early days of IVHS to the present, traveler information has always provided a tantalizing business opportunity for technology companies. Early on business success did not live up to expectations with various companies attempting different types of delivery and business models of which most failed. However, one company, Westwood One with its combined Metro/Shadow Networks traffic broadcasting service developed a business model that has succeeded nationally and endured for several decades. Some relatively new firms, like Inrix and Traffic.com, appear to have developed business models that may succeed. With the integration of traffic information in in-vehicle guidance systems that provide route choice options and the availability of additional forms of traveler information such as travel times, border crossing delays, and video we should continue to see traveler information business opportunities expand. We would expect to see businesses delivering traveler information continue to slowly grow into the future.

The idea of turning over the delivery of travel information to the private sector has been an attractive one for state departments of transportation. Government agencies have trouble keeping up with the latest technology and are usually unsuccessful in efforts to market their services. Each new firm has tempted various state DOTs to form partnerships to deliver travel information. WSDOT joined forces with Seiko to deliver en-route travel information via the Seiko pager watch and with Microsoft to deliver information as part of its Sidewalk travel information web site. Neither of these companies offers these services today. WSDOT is currently working with Traffic Gauge to deliver information on their handheld traffic device. WSDOT's attempts to work with the private sector have focused on offering customers something different or better than what is currently provided. The motivation in the case of the Seiko watch or the Traffic Gauge device was en-route travel information that was more frequent and better than what was available over the car radio. Personalized travel information was the motivation in the case of the Microsoft web site. Live, full-motion video available on a handheld device is the motivation of the current discussions mentioned above. This tremendous industry turnover has left most state DOTs wondering how the public and private sectors should work together on travel information and what the respective roles of each should be.

The prevailing view seems to be that the public sector role is to install, maintain and operate the infrastructure that is needed to operate and monitor the performance of the transportation system. In most states and/or urban areas, the public sector has chosen to offer a basic level of free travel information using technology that can be added to its transportation operations systems at little incremental costs. Thus WSDOT, like many other state departments of transportation, offers the public a version of the congestion map that it uses to

monitor traffic conditions. This is available over the Internet at the cost of an increasing number of servers to handle an increasing volume of users. The information is also available over the telephone by dialing 511, which is also driven by the data that is collected for operations purposes. As these systems attract larger audiences, the costs for these services become greater, causing most DOTs to constantly reassess whether they or the private sector should be providing these services. The flux in the industry has kept the public sector in this business, and customer feedback indicates that the public supports keeping this effort publicly funded with little or no advertising.

The private sector has focused on providing a type of “premium” travel information service. They have tried delivering the information on devices that are simpler, faster or more convenient than the telephone or a laptop or home computer browsing the Internet. They have tried offering the ability to customize the service by letting the user specify the type of information that is desirable (time of day, route, and level of disruption).

WSDOT’s direction in the area of travel information will be to continue to offer a comprehensive, accurate, real-time, free, basic level of travel information using as many media as possible. WSDOT will look for ways to offer both pre-trip and en-route travel information, realizing that with current technology it is difficult to deliver en-route information that is timely enough to be used by travelers. WSDOT will continue to support the efforts of the private sector to



deliver an improved or premium level of traveler information. WSDOT should explore, however, the use of private server- farms or an Internet Service Provider to provide the peak period capacity that it requires during emergencies when the public demand for travel information increases by four to six times. Some states are electing to contract with private companies for travel information. One such company, INRIX, combines public sources of real-time and historical data with toll-tag data and GPS-strobe vehicle data from a fleet of commercial vehicles like taxis and delivery vehicles to provide real-time and predictive traffic and speed information.

Actions: Section V references a project list, included in Appendix A. The priority projects listed are identified in the “Operating Efficiently” and “Managing Demand” strategic elements of *Moving Washington*. However, *Moving Washington* does not identify any statewide projects. The key statewide traveler information projects are listed



below.

- As the most comprehensive source of both pre-trip and en-route travel information, the 511 telephone hotline is an important resource for WSDOT. An upgrade of the system is badly needed. The new system would be a portal for travel information, including information on transit and other modes. It should also have improved computer-generated voice and improved caller ID that would allow other personalization features.
- Work is underway to develop the functional requirements for an improved travel information web site but the project has no funding. This upgrade should include a new version of the Condition Acquisition and Reporting System (CARS) for recording and displaying information on statewide incidents and weather- or construction-related closures. This improved travel information system would provide users with the ability to develop their own travel information web page so they could quickly access the WSDOT information that is of most interest to them. The website should also provide users with the capability to plan trips by entering an origin and a destination and giving them the ability to compare travel times by different modes.

Research: The following are key research topics in this area:

Develop a method to quantify the mobility and safety benefits of providing traveler information.

Develop a standard way to display arterial traffic congestion on a map.

Test new sensors that can determine road surface conditions for accuracy and reliability.

Policy: The key policy initiative is for WSDOT to understand its role as a regional and statewide information provider. It manages a large communications infrastructure and collects a large quantity of valuable information that is in great demand. WSDOT should realize that an important part of its overall mission should be to provide its customers with comprehensive travel information that is integrated with that of other agencies, including agencies that manage other modes.

WSDOT also should take the lead in promoting the sharing of data. For travel information to be maximally useful, the public needs a one-stop-shop for travel information. This requires local agencies to share data and provide data in a standard format so it can be displayed on an integrated web page. WSDOT should assist local agencies with those efforts.

2. Improve safety and crash avoidance.

Opportunities: WSDOT, along with the Washington Traffic Safety Commission, Washington State Patrol, Department of Licensing and other safety partners, developed a strategic highway safety plan, Target Zero, to reduce traffic fatalities

to zero. This involves a comprehensive program of enforcement, education and engineering. Many experts believe that engineering improvements are reaching the limit of what can be achieved to make the roadside and the vehicle safe. Freeway median barrier, impact attenuators, seat belts, front and side airbags, and traffic signal all-red intervals have succeeded in reducing the fatality rate to the lowest in history. But there are still over 40,000 fatalities in the US annually. Work currently underway indicates that ITS can shift the emphasis away from surviving a crash to avoiding it. Using in-vehicle warning and control systems, ITS can offer a way to significantly reduce the number of fatalities and help achieve the Target Zero goals.



ITS can help drivers avoid hazardous mistakes by minimizing distraction, helping in degraded driving conditions and providing warnings or control in imminent crash situations. ITS can also improve safety by automating the enforcement of traffic laws.

To achieve the expected safety improvements, the majority of new technology is expected to be installed in the vehicle. There are at least four kinds of in-vehicle electronics products that are of interest:

- Information products such as route guidance and traffic advisories
- Diagnostic products such as low tire pressure warnings and cargo security
- Driver assistance products such as curve speed warning, collision warning, stability control and lane departure warning
- Active safety products such as forward and rear collision avoidance and lane departure prevention.

Many of the applications made possible by these products will depend on, or will perform better if furnished with, data from the roadside, a traffic center or other vehicles. In addition, the sensors in these vehicles will also provide a source of data for many transportation operations applications. Data on speeds, travel times, traction or road surface conditions and collisions will be available to traffic management centers from a large stream of probe vehicles. Clearly, some interaction between vehicle and roadside systems, requiring some public sector infrastructure, will be needed in the future. The question that is likely to remain unanswered for the next 5 to 10 year concerns the balance between vehicle based and infrastructure based systems. FHWA is attempting to provide guidance in this area by leading the Vehicle Infrastructure Integration (VII) effort. WSDOT is one of the states that is participating in that effort. We have formed a WSDOT VII Review Team to support our involvement in the FHWA's Federal Working Group. The WSDOT team is working to develop deployment scenarios, primarily involving commercial vehicles, which can be proposed to FHWA as candidates for

operational test funding. Much work is underway to determine the full range of VII applications and determine the costs and benefits of the implementation of this technology. Additional information can be found at <http://www.vehicle-infrastructure.org/>.

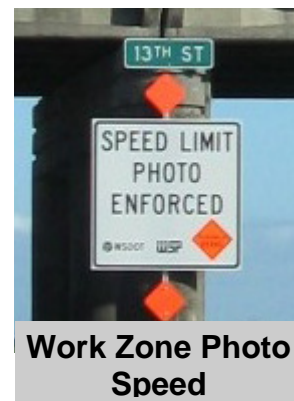
Technology could also improve safety through the automated enforcement of traffic laws.

The following are some examples:

- Ignition interlocks that require a valid drivers license to start the car
- Ignition interlocks that test blood alcohol levels or other tests to prevent impaired or drowsy drivers from starting the car
- Automated hours of service monitoring and reporting systems for truck drivers
- Automated red-light running, highway-rail crossing and speed enforcement, including speed enforcement in construction or maintenance work zones. (The legislature recently gave WSDOT the authority to conduct a test of work zone photo speed enforcement on state highways.)

It is also important to note that the delivery of real-time travel information concerning collisions and other non-recurring delays can improve safety by reducing secondary collisions as motorists use the information to avoid traffic jams.

Benefits: Improving safety saves lives, time and money. Emphasizing crash avoidance rather than crash survival will maximize the savings in all three categories. The envisioned systems can potentially provide additional access and mobility for elderly or disabled drivers. Some of these in-vehicle systems can also help to save fuel and reduce emissions by smoothing acceleration and deceleration (particularly for trucks and transit vehicles) and by enabling trucks or transit to operate in platoons.



The aggressive deployment of driver/operator license and impairment checks could result in the elimination or reduction in severity of 50% of all fatal crashes. Evaluations of red light running enforcement programs indicate that violations decrease over time and related crashes at intersections are reduced by about 15%.

Challenges: Deployment of the crash avoidance and safety systems present the greatest challenges to state departments of transportation of any ITS. The key issue, as mentioned previously, is to achieve the optimal balance between in-vehicle and roadside infrastructure; or between public and private infrastructure. Optimal, in this case, refers to a system that achieves the maximum benefit in improved safety with an acceptable cost in infrastructure deployment and

maintenance.

Many other issues will need to be resolved before systems like this are widely deployed. Some of these issues concern:

- Liability – Who will be liable when a collision occurs because a system is not working? Will there be an expensive forensic investigation to determine if the roadside or the in-vehicle system malfunctioned and, if so, who will pay for the investigation?
- Human factors – What level of warning, assistance or control will be acceptable? At what point do all the warnings, phone rings, navigation prompts, and entertainment sounds cause so much distraction that they cause collisions rather than prevent them?
- Standards – What level of cooperation can be expected between the many vehicle manufacturers and the 50 state departments of transportation?
- Communications – What are the communications and computing requirements to collect and process all of the data that are available from all of the millions of potential probe vehicles on the roads? Do the benefits of this data justify the costs of collecting and processing it?
- Societal Issues – What level of regulation and enforcement does the public support in order to improve safety? While there are laws against driving without the proper credentials, impaired driving, speeding and red-light running, and a great deal of resources are dedicated to enforcement, the chances of being caught are low. In many cases, the penalties are also low. In most cases, the enforcement takes place after the fact, either via observation of the unlawful behavior or during a crash investigation. ITS could change this situation if the public finds that the savings in lives, time and money are more valued than perceived loss of privacy and personal autonomy.

Number of incidents lasting over-90-minutes by type

Based on statewide responses by WSDOT

Response Type	2006-2007 2-year avg.	2008 actual number of responses	
		Q1	Q2
Abandoned Vehicle	2.4	4	2
Disabled Vehicle	26.6	19	7
Debris Blocking Traffic	7.9	3	4
Fatality Collision	30.6	29	14
Injury Collision	66.8	50	49
Non-Injury Collision	51.1	47	19

Source: WSDOT Traffic Office

Actions: WSDOT representatives will continue to be involved in the FHWA VII initiative and participate in model deployment projects as they become available.

Research: Most of the research needed to fulfill the promise of ITS in this area would pertain to nationwide deployments and is likely to be funded by federal transportation agencies. WSDOT, however, should investigate the following:

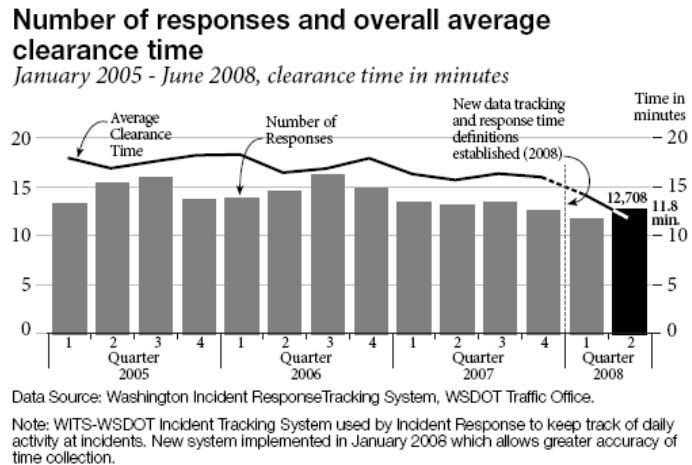
- How should automated enforcement systems be deployed around the

- state to achieve the greatest safety benefit within societal norms?
- How can the privacy of the public be ensured despite all the data on travel behavior being collected by public agencies and private companies?
- How much probe vehicle data is enough and how much is overkill, given the price of communications and computing infrastructure?

3. Improve the detection of incident occurrence and severity, notification and response.

Opportunities: Getting emergency response teams to an incident scene as quickly as possible is critical to saving lives. In order for a response to be effective, first responders must:

- Receive timely notice of an incident, including its location and characteristics
- Receive information that allows efficient routing to the scene and to a hospital
- Be able to assess and share information on the nature and degree of injury with the receiving medial facility



In addition, an effective response includes safe traffic management at the incident scene. This includes returning traffic flow to normal as quickly as possible to avoid secondary collisions in the traffic queue caused by the incident.

ITS can help achieve these goals. Both roadside systems, such as CCTV surveillance cameras, and in-vehicle systems, such as mayday systems, can be used to detect and locate a crash. Information about the location and severity of a crash can be immediately provided to first responders. Various traffic management and travel information systems can be used to keep traffic disruptions to a minimum. For example, speed harmonization systems, generally included as part of Active Traffic Management (discussed later) can help to reduce the stop-and-go conditions caused by incidents and, therefore, reduce secondary collisions.

Navigation devices that incorporate real-time traffic congestion information can be used to provide optimal routing to emergency vehicles. Emergency vehicle traffic signal preemption systems can help to get emergency vehicles to the scene as quickly as possible. Advanced communications technologies can be used to connect responders at the scene with medical center trauma experts to share information on the number and severity of injuries. Similar communications technologies can be used to connect responders on the scene with hazardous

materials experts in the event of a spill. The key to success in this emphasis area is interoperable and improved communications between public safety answering points (PSAPS – generally 911 call centers), first responders (generally emergency medical technicians (EMT) and or law enforcement), TMCs, and private telematics providers (On Star, for example.) It may also be necessary to include some agencies that are not usually involved in emergency response in order to prepare for natural or man-made disasters. Transit agencies, for example, would need to be involved in any large-scale evacuation of an urban area, or the Washington State Ferry System and the US Coast Guard might be involved in an evacuation over water during an earthquake when all roads leading from Seattle are impassable.

Benefits: Quicker crash detection and emergency response will save lives. However, from a traffic perspective, the biggest benefit of improved emergency response is the reduction in delay and secondary collisions due to quicker, more efficient, and more coordinated emergency response.

Challenges: There are good surveillance systems and communications coverage in most urban areas. In rural areas, however, where there is a longer emergency response time, and, therefore, the detection time is more critical, surveillance and basic communications, like cellular phone coverage, are limited. In these rural areas, quicker emergency response will require collaboration between the public and the private sectors. State agencies often own strategic high elevation sites that can be shared with private sector companies to provide communications in rural areas. The indication that an airbag has been deployed by a vehicle in a rural area that is received by a private telematics company, like On Star, can be relayed to a public emergency management agency to provide a response. Eventually, when the wireless phone system has the capability to automatically locate callers, this service will be provided to all cellular phone users.

The crucial problem for WSDOT in this area is the procurement of an interoperable radio communications system that has enough bandwidth to carry WSDOT data, including video images. Several communications studies have been done to assess communications needs and propose a communications system to meet those needs. An effort began in 2008 to plan and implement the rebanding of the existing 800 MHz radio system but does not include any system upgrades or expansion. Without a wireless system with the bandwidth to transmit large amounts of data, WSDOT lacks the capability to send or receive data like traffic congestion maps, video images, position data or function data (snowplow up or down, deicer spreader on or off) between vehicles and a TMC. (As mentioned previously, WSDOT is conducting a pilot project using a 700MHz/4.9GHz system for data transmission.) Without this ability to track and truly dispatch incident response and maintenance vehicles, WSDOT's ability to improve the efficiency and coordination of its incident response is limited.

Actions:

Section V references a project list, included in Appendix A. The priority projects

listed are identified in the “Operating Efficiently” and “Managing Demand” strategic elements of *Moving Washington*. The key statewide incident detection and notification projects are listed below.

- The list included in Section V includes a project to equip the South Central Region’s maintenance vehicles with an automatic vehicle location system. All other regions have shown an interest in equipping vehicles, especially incident response vehicles, with an automatic vehicle location system.
- WSDOT should implement a true incident response dispatch system that is compatible with the one that WSP uses. A combined WSDOT/WSP dispatch system operated by WSP would provide the most effective and coordinated incident and emergency management.
- WSDOT should implement a statewide wireless communication system that has the bandwidth to carry data, which would allow traffic congestion maps or video images from traffic cameras to be viewed in vehicles. Ideally this would be done in cooperation with the WSP in conjunction with the implementation of the common dispatch system discussed above.

Research: Research that can measure the benefits of providing interoperable wireless communications is needed. A credible estimate of the efficiency gains from tracking and dispatching emergency response vehicles and being able to share data with WSDOT vehicles and those of other agencies is needed.

Policy: A funding source for communications projects like the deployment of a statewide, wireless communications system for the agency needs to be identified and prioritized.

4. Providing advanced transportation management.

Objectives: Future advances in technology in this emphasis area will be mostly evolutionary rather than revolutionary consisting of new detector systems, new surveillance systems and new communications technologies. More data will be available for new algorithms to use to optimize traffic flow. The most revolutionary new developments will take place in the way these systems are integrated and operated.

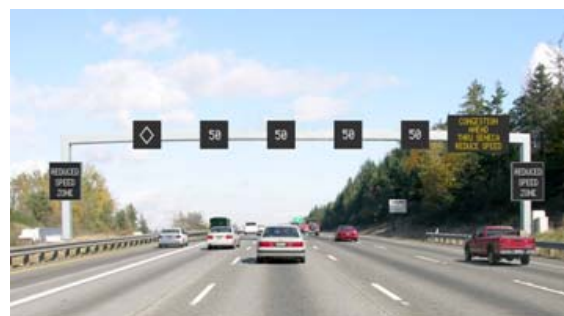
WSDOT was an early implementer of advanced traffic management systems, particularly freeway management systems, in an effort to maximize the throughput of its geographically constrained roadway system in the central Puget Sound area. The majority of the ITS infrastructure in the state is used to provide data and management capabilities for the central Puget Sound area freeways, but the urban areas of Tacoma, Spokane and Vancouver are also deploying freeway management systems. As more roadways and greater stretches of existing roadways come under management, the opportunities for cooperative and coordinated management are increased. The Federal Highway Administration

(FHWA) has begun to promote the concept of Active Traffic Management (ATM). It is a concept developed in Europe and demonstrated to region transportation managers during a recent FHWA sponsored “Scanning Tour.” It has many components in common with the current WSDOT Surveillance, Control and Driver Information (SC&DI) system, reversible roadway systems and Incident Response system. Active Traffic Management coordinates the operation of these systems under one operations concept and adds some components that the region has considered but not adopted, such as hard shoulder running and variable speed limits, now called speed harmonization. In addition, other techniques to be evaluated as part of the Active Traffic Management concept of operations queue warning signs that warn motorists of downstream backups, junction control systems that use signs and pavement markings to direct traffic to specific lanes, and dynamic rerouting systems that change destination signs to account for current traffic conditions. Tolling systems that use congestion pricing (varying tolls depending on the time of day and the amount of traffic on the road) would probably be part of any future traffic management system.



WSDOT is leading the effort to implement Active Traffic Management in the central Puget Sound area in cooperation with several local and regional agencies. Several ATM demonstration sites are under development, with the section of northbound I-5 from the Boeing Access Road to I-90 to be operational by 2010. Other areas where ATM is planned include SR520 and I-90 from I-5 to I-405.

WSDOT was also an early adopter of arterial traffic signal control but, as more area in central Puget Sound was incorporated into new cities, an increasing number of traffic signals also moved under local agency control. WSDOT is starting to play a key role in regional operations efforts due to the fact that it operates the only 24/7 TMC in the central Puget Sound area. Work is underway in the Seattle area, led by the Puget Sound Regional Council (PSRC), on a regional concept of operations and a regional ITS plan. The PSRC recently formed a Regional Traffic Operations Committee (RTOC) to work on these initiatives and others promoting regional operations.



Proposed variable speed limit signs on I-5

This effort was given a boost by the selection of WSDOT’s Traffic Buster project by

PSRC for funding under its Surface Transportation Program (STP)/Congestion Mitigation and Air Quality (CMAQ) funding competition. Traffic Buster will provide the infrastructure to connect additional Puget Sound area agencies to the WSDOT fiber optic communications network. When this project is complete, it is expected that approximately 20 agencies will be connected to the fiber network. Agencies will be able to share video from CCTV cameras and data from traffic signal systems. This infrastructure and the regional concept of operations will provide what's necessary to adopt a regional approach to traffic operations in time to manage the major bridge and roadway



construction projects expected to be underway in the near future. In other areas of the state, notably Spokane and Vancouver, WSDOT is part of multi-agency groups that are working to improve traffic signal coordination and operations.

These efforts to coordinate the operation of freeway and arterial management systems and get jurisdictions to take a regional view of transportation operations have been advancing by “fits and starts” for many years. The major construction projects on nearly all of the key roadways in central Puget Sound, mentioned above, which will require significant, long-term efforts to manage traffic on alternate routes, particular arterial roadways managed by local agencies, are providing the motivation for agencies to work together. These major construction projects also have the potential to provide construction mitigation funding that could be used to purchase equipment that will facilitate regional operations. The Federal Highway Administration has initiated a program called Integrated Corridor Management (ICM) that has also stimulated progress and provided funding for regional operations. Seattle was recently chosen to receive funding as one of eight “Pioneer Sites” to develop an ICM concept of operations. The application was a cooperative effort of the City of Seattle, King County Metro Transit and WSDOT with assistance from Siemens. While the site proposed for the ICM project was the I-5 corridor from the SoDo area of Seattle south to Federal Way, it was the intent of the team to develop a concept of operations that could be used at any site where ICM was appropriate. Future federal ICM funding will be offered to selected sites to proceed further with design and implementation and WSDOT hopes to be one of those sites.

Two other new developments could also bring about revolutionary changes in traffic management. As mentioned under emphasis area 2 (improve safety and crash avoidance), the installation of new in-vehicle electronics products has the potential to provide a new source of data to TMCs, particularly if coupled with communication to roadside equipment. The circulation of large numbers of probe vehicles transmitting data on location, speed, traction conditions, road surface conditions and collision occurrence could dramatically change the way traffic is managed.

Tolling will offer additional traffic management opportunities. Electronic tolling will make it possible to vary charges based on time of day or levels of traffic congestion. This will enable agencies to set road user charges at levels that will regulate levels of congestion. These operating strategies will need to be coordinated with transit management systems and arterial traffic signal systems so that diverted travelers and vehicles can be



Electronic Toll lanes at the Tacoma Narrows Bridge

accommodated on other modes or roadways. The Seattle area was selected as one of five cities to participate in the FHWA's Urban Partnership Agreement program. It provides funding and the flexibility to use other federal funding for demonstration projects to implement tolling to mitigate congestion. The tolling is part of a "Four Ts" approach: Tolling, Technology, Transit and Telecommuting. WSDOT has proposed the SR 520 corridor for this program.

The situation has never been more favorable to achieve the goal that has eluded WSDOT, and all of the agencies that manage transportation for many years in central Puget Sound, of regional, coordinated transportation operations. (Areas with fewer regional partners, like the Spokane and Vancouver, WA urban areas have had an easier time getting started on this goal.) Integrated Corridor Management, Active Traffic Management, Vehicle Infrastructure Integration (VII) and congestion pricing tolling, if implemented in a planned and coordinated way, could result in significant benefits for commuters and other travelers. The infrastructure and management techniques are available and significant funding is available. WSDOT will pursue these transportation management strategies that have demonstrated their effectiveness in other parts of the country and the world.

Benefits: Improved traffic management leads to improved system reliability and safety, more effective incident response and better coordination of traffic and travel across jurisdictional boundaries and modes. All of these result in a reduction in travel times, congestion and collisions.

Challenges: The primary short-term challenge is a lack of funding for the ITS infrastructure that would allow the most efficient traffic management to occur. This includes everything from additional detection and surveillance hardware, to monitoring software, to new, replacement TMCs.

To get the maximum benefit from the various traffic management systems deployed around the state, they should be linked so that data can be shared. This would allow various TMCs to serve as back up centers in the event that one or more are shut down by power or communications failures or other causes.

Statewide implementation of a center-to-center (C2C) communications standard is needed as soon as possible.

Actions: Section V references a project list, included in Appendix A. The priority projects listed are identified in the “Operating Efficiently” and “Managing Demand” strategic elements of *Moving Washington*.

While not, strictly speaking, a traffic management project, a project to monitor the security of roadway systems is discussed here because any system will need to use the traffic management system infrastructure to conduct surveillance, transmit data and monitor or respond to threats or actual damage. WSDOT, in cooperation with other agencies with responsibilities for critical infrastructure, will need to analyze the critical nodes in their system, harden them in some appropriate fashion, and monitor them to see that they continue to operate.

Research: The following research needs to be conducted in this area:

- Continue the work already started to establish a detector and surveillance test section on I-5 in Olympia in conjunction with the University of Washington.
- Conduct more operational tests of adaptive signal control systems.
- Investigate congestion management tolling strategies.
- Determine what number of probe vehicles are necessary to provide accurate, precise, and reliable traffic management data for all classes of roadways in the state.
- Investigate the feasibility of truck only lanes. As part of this, investigate the feasibility of automated truck, bus or automobile lanes.

Policy: Participate in work led by PSRC on the development of a regional concept of operations. This would determine the situations that would lead to local agencies sharing control with other agencies, including WSDOT since it operates the only TMC that is staffed 24/7. Control to activate a pre-approved signal timing/route diversion plan would pass to the other agency when an agreed upon scenario occurs.

As mentioned previously, a regional outreach program is needed to inform the public and solicit their input on the use of probe vehicle information (generated by private vehicles) and tolling strategies to reduce congestion.

V. Prioritized Project List

The benefits of ITS strategies have always been clearly identifiable yet difficult to quantify, especially when compared to capacity improvement projects. One of the reasons that the analysis of ITS applications has been so difficult is that many ITS applications represent complex interactions between operating systems and traveler behavior. ITS applications are different from many traditional transportation strategies (particularly capacity-enhancement strategies) in that they are operated, not merely implemented and fixed forever. Many ITS applications assimilate

information and present it to the traveler so that the traveler can make choices. The travel market that receives the information is often not well understood, and the traveler response to that information is even less understood. While benefits of individual ITS projects may be small, the cumulative benefit of these investments multiply as projects are expanded piece by piece over a large area to become a comprehensive network of ITS applications.

In 2006, the IBI Group, under contract to WSDOT, asked each WSDOT region Traffic Operations office to identify their top ITS projects. IBI Group then ranked the project list in priority, using both quantitative and qualitative factors. The analysis had the following three steps:

- A qualitative analysis
- A quantitative analysis of monetary benefits, which served as a tie-breaker to distinguish similarly ranked projects
- A final adjustment to account for dependencies and relationships between projects

The qualitative criteria used to assess the proposed projects were:

- Perceived benefit to the customer
- Immediacy of need
- Ease of implementation
- Regional benefits
- Improved safety
- Decreased congestion

Each project was rated high, medium or low for each of these criteria. These ratings were then given numeric scores, which were totaled. The projects were then ranked by their qualitative scores, independent of the region in which they are located. They were then grouped in the following three categories:

ITS projects included in the Nickel/TPS projects

- Funded projects
- Non-funded projects

ITS projects within corridors that connect to or are parallel to Nickel/TPA projects which would significantly benefit those corridors

Remaining Core ITS projects

The qualitative (tie-breaker) analysis was based on an estimation of benefits due to reduced congestion and/or collision rates. The benefits information was based on published ITS benefit information from FHWA.

Since the 2006 effort by IBI, WSDOT has worked to refine the process for estimating and quantifying benefits for ITS strategies. Recent efforts used to estimate the benefits of individual ITS projects are based on FHWA's Intelligent Transportation Systems Deployment Analysis System (IDAS) software. IDAS is a sketch-planning software analysis tool used to estimate the benefits and costs of

ITS investments. IDAS can predict relative costs and benefits for more than 60 types of ITS investments. WSDOT's Systems Analysis and Program Development office has recently begun using IDAS to calculate benefit/cost information for ITS solutions identified in the 2006-2027 Highway Systems Plan.

The full project list is included as Appendix A. The projects listed are key elements of Moving Washington. The projects labeled "Priority Projects" are the same projects mentioned in Moving Washington as those that should be complete or underway within the 2009-2011 timeframe.

Almost all of the projects on this list are basic traffic management infrastructure projects. They complete the surveillance, control and driver information systems and the required communications systems that are necessary to gather performance data, operate the system for maximal efficiency and provide travel information. This evolutionary approach is to be expected under the conditions of increasing congestion and safety problems that are being experienced in all of the WSDOT regions. The majority of the priority projects contain some combination of fiber optic cable or other communications system, closed circuit TV cameras, data stations, ramp meters, or highway advisory radios. The same project mix is generally found in the second group of projects.

Note that this discussion does not include the installation of High Occupancy Toll (HOT) lanes or other tolling systems installed either for congestion management, revenue generation or both. Tolling systems will have significant ties to and interactions with ITS, particularly systems installed for traffic management and particularly in the case of tolling done to reduce congestion. TMCs will be called upon to provide real time traffic volumes, speeds, and/or travel times to tolling systems that will establish toll rates using congestion management algorithms designed to maintain acceptable levels of service on major state or regional roadways. WSDOT's Urban Corridors Office (UCO) is working with the Puget Sound Regional Council and several other agencies in the central Puget Sound to develop a tolling concept of operations. UCO is also working to promote Active Traffic Management demonstration projects as part of several large construction projects in central Puget Sound. WSDOT is also leading the Integrated Corridor Management and the Urban Partnership Agreement efforts. All of these efforts need to be coordinated to ensure that when tolling is implemented, the freeway, arterial roadway, and transit systems are operated as efficiently as possible so that travelers have alternatives to high, peak period, freeway tolls.

VI. The Long View

It's been said several times before but, in general, WSDOT's ITS plans are evolutionary and not revolutionary. Nothing in the near term future will change the way people travel to work or play. The vehicles will stay pretty much the same. The type of fuel, the safety attributes and the way the vehicle is operated will change but drivers will continue to mainly use personal vehicles with four, rubber-tired wheels propelled by some combination of internal combustion engine and/or

electric motor. And they are likely to be driven, albeit with increasing assistance, by a very fallible human driver. However, implementing technologies such as ATM and VII will help mitigate human-caused incidents.

Recurring congestion, incidents, construction delays and special events will all continue to occur and transportation management efforts will be more crucial than ever. Solving the institutional, jurisdictional and leadership issues necessary to implement what to some might seem more Draconian congestion management schemes, will be the biggest challenge. Here are some other key issues that are likely to arise in the future:

There is no single solution, but a package of strategies and initiatives that presents an opportunity for creativity

ITS: The term “Intelligent Transportation Systems” is outdated and will probably disappear in the future in favor of the broader and more descriptive term, System Operations and Management (SOM). SOM encompasses freeway operations, including active traffic management, arterial operations, integrated corridor management, managed lanes, congestion pricing, incident management, transit signal priority and many other forms of transportation operations. The various technologies that comprise Intelligent Transportation Systems are used to implement these operations concepts.

In addition, with no federal funding category for ITS, the only way to get these projects funded is to include them in the mainstream transportation planning, programming, and funding processes. That is likely to be more successful when the project being proposed consists of an operations concept, like Integrated Corridor Management, than when it consists of a bundle of technologies like fiber optic communications systems to connect ramp meters and arterial traffic signals.

Funding: As mentioned above, without a dedicated source of funds, such as Congressional earmarks, ITS projects will need to compete with other types of transportation projects for funding. The effort to develop a method to calculate benefits for most types of ITS projects lags behind traditional roadway improvement projects. Part of the reason was the availability of Congressional earmarks as an alternative source of funds for ITS projects. Since that funding source has disappeared, there has been some renewed effort to develop a way for ITS projects to compete with traditional transportation projects. It should be easier to accomplish this if the projects being proposed are Integrated Corridor Management or Active Traffic Management projects where the individual project components are bundled into an operating concept and the cumulative benefits, therefore, are easier to estimate. In many cases, the equipment, concepts and strategies for Integrated Corridor Management or Active Traffic Management might be included as traffic control strategies for major construction projects thereby eliminating the need to appropriate separate funds for these projects.

Vehicle or Roadside: A major question for the future will concern the location of the “intelligence” in Intelligent Transportation Systems. The current trend is to put most ITS hardware in the roadside. Following are some examples of the challenges with this approach:

Maintenance of the current traffic and transportation management systems is clearly not adequate and it is not likely to be so in the future. With increasing demands on department of transportation staff to keep toll systems and various traffic management systems in operation, there will be few resources available to keep VII systems in operation, particularly those associated with non-safety systems. Without a dedicated funding source for operations and maintenance, WSDOT may be forced to choose not to participate in roadside system designs.

Liability will be difficult to assign where part of the system is vehicle based and part is infrastructure based and where part of the system is maintained by the vehicle owner and part by a government agency.

Billing for commercial applications that use VII infrastructure will be particularly cumbersome with agencies required to exchange data with private companies that charge for services. Using public agency roadside equipment for vehicle software upgrades would appear to have potential problems.

The life cycle of vehicles is much shorter than the life cycle of most transportation infrastructure. New versions of software and hardware can be installed in vehicles easier than it can be installed in roadside equipment.



These are just a few of the major challenges and they are not insurmountable but appear to favor a vehicle-based solution to most of the problems that the Vehicle Infrastructure Integration (VII) program is designed to solve. With the ever increasing accuracy of mapping and GPS, it would seem that most of the safety applications promised by the advocates of VII could be accomplished more effectively by a vehicle-based solution.

Public or Private: There appears to be increasing pressure to reduce public expenses by privatizing services traditionally provided by the public sector. Freeway management, incident response, highway maintenance, transit operations, etc., have all been tried by the private sector. None of these efforts have been successful enough to have spread beyond one or a few locations or lasted longer than a trial period. The inability to develop adequate performance standards, the need to generate profit and the lack of accountability to the public, argue for the management of transportation systems to remain a public sector function.

Most Significant Influence in the Future: The increase in people’s ability to do things from home or other remote locations will result in a drop in personal travel that will have a major effect on transportation. More people will choose to work

from home, shop from home, learn from home and be entertained from home. All this may not reduce the demand for travel mobility or congestion levels by a significant amount but it will change the pattern of travel. Not too many years ago, the afternoon peak period consisted of mostly commuting traffic. Now most peak period travel consists of people doing something other than traveling home from work. In the future most daily traffic could be discretionary and it will be even more difficult to plan for and manage.